(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 610 931 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
16.04.1997 Bulletin 1997/16

(43) Date of publication A2:
17.08.1994 Bulletin 1994/33

(21) Application number: **94102063.8**

(22) Date of filing: **10.02.1994**

(51) Int. Cl.[6]: **C21D 8/02**

(84) Designated Contracting States:
DE FR GB

(30) Priority: **10.02.1993 JP 22901/93**
16.02.1993 JP 26879/93
18.02.1993 JP 29143/93
08.09.1993 JP 223610/93

(71) Applicant: **NIPPON STEEL CORPORATION**
Tokyo 100 (JP)

(72) Inventors:
- **Yoshie, Atsuhiko,**
  c/o Nippon Steel Corporation
  Futtsu-shi, Chiba (JP)
- **Fujita, Takashi,**
  c/o Nippon Steel Corporation
  Futtsu-shi, Chiba (JP)
- **Fujioka, Masaaki,**
  c/o Nippon Steel Corporation
  Futtsu-shi, Chiba (JP)
- **Nomiyama, Yuji,**
  c/o Nippon Steel Corporation
  Oita-shi, Oita (JP)
- **Miyawaki, Hiroki,**
  c/o Nippon Steel Corporation
  Futtsu-shi, Chiba (JP)

(74) Representative: **VOSSIUS & PARTNER**
Siebertstrasse 4
81675 München (DE)

(54) Production method of strong and tough thick steel plate

(57) A steel containing predetermined components is rolled in a recrystallization temperature region or a non-recrystallization temperature region of an austenite and is subsequently subjected to repeated hot bending. Alternatively, a surface layer portion is cooled during rolling of the steel described above to an α single phase or a γ/α dual phase temperature region, rolling is then effected and is finished at the point of time when the surface temperature of the plate rises above an Ac_3 point due to recuperative heat, and repeated bending is carried out. Still alternatively, the steel described above is rolled to a cumulative reduction ratio of at least 20% in the non-recrystallization temperature region and is then subjected to repeated bending. Further alternatively, the surface layer portion is cooled during hot rolling of the steel described above to an α single or γ/α dual phase temperature region, rolling is then continued at a cumulative reduction ratio of at least 20% and is finished at the point when the surface temperature of the steel plate rises less than (Ac_3 point - 200°C) due to recuperative heat, and subsequently, repeated bending is carried out.

EP 0 610 931 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 10 2063

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	DE 25 37 188 A (BWG BERGWERK WALZWERK) 24 February 1977 * the whole document *	1	C21D8/02
A,D	GB 2 001 673 A (NIPPON KOKAN KK) 7 February 1979		
A	PATENT ABSTRACTS OF JAPAN vol. 016, no. 443 (C-0985), 16 September 1992 & JP 04 154912 A (KAWASAKI STEEL CORP), 27 May 1992, * abstract *		
A	PATENT ABSTRACTS OF JAPAN vol. 016, no. 013 (C-0901), 14 January 1992 & JP 03 232923 A (NIPPON STEEL CORP), 16 October 1991, * abstract *		TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A,D	PATENT ABSTRACTS OF JAPAN vol. 009, no. 036 (C-266), 15 February 1985 & JP 59 182916 A (SUMITOMO KINZOKU KOGYO KK), 17 October 1984, * abstract *		C21D
A	METAL SCIENCE AND HEAT TREATMENT, vol. 33, no. 7 / 08, 1 July 1991, pages 503-505, XP000329903 KSENOFONTOV A G: "HIGH-TEMPERATURE THERMOPLASTIC STRENGTHENING OF STEELS ST3SP AND 09G2S"		
	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 February 1997	Mollet, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 10 2063

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	METAL SCIENCE AND HEAT TREATMENT, vol. 31, no. 1/02, 1 January 1989, pages 108-114, XP000074664 SPASSKII M N ET AL: "MICROSTRUCTURE OF STEEL 20 STRENGTHENED BY HIGH-TEMPERATURE MULTIPLE COMPLETELY REVERSED BENDING" -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 February 1997	Mollet, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)